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Assessment of Soil Quality Indicators of Soil from Different Departments of NAI, SHUATS, Prayagraj

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An assessment of soil health parameter properties of soil from different departments of NAI, SHUATS, Prayagraj carried out during 2022-23. The prime objectives of this study were to carry out the soil health parameter properties of soil at different depths of various department research farm to determine the availability of macronutrients and micronutrients in soil of these soil sample provide the assessment 7 sampling locations were selected. Soil samples were collected with depth of 0-15, 15-30 and 30-45 cm respectively. The soil colour dry condition varied from Light yellowish brown, dark yellowish brown, Pale olive, pale brown, pale yellow, Light olive brown,

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Yellowish brown, Olive yellow, Dark brown and in wet condition varied from Olive brown, Olive, Dark brown, Dark yellowish brown, light olive brown, Olive yellow and Dark yellowish. The soil texture was dominantly sandy loam in every site. The bulk density ranged from 1.170 to 1.432 Mg m^{-3}. The Particle density ranged from 2.22 to 2.50 Mg m^{-3}. The pore space ranged from 42.50 to 51.24 %. The soil pH ranged from 7.37 to 7.78. The electrical conductivity ranged from 0.28 to 0.44 dS m^{-1}. The soil organic carbon ranged from 0.16 to 0.42%. The available nitrogen ranged from 195.5 to 256.0 kg ha^{-1}. The available phosphorous ranged from 14.43 to 23.95 kg ha^{-1}. The available potassium ranged from 132.00 to 206.00 kg ha^{-1}. The available calcium ranged from 0.97 to 1.88 cmol (p+) kg^{-1}. The available magnesium ranged from 0.76 to 1.69 cmol (p+) kg^{-1}. The available zinc ranged from 0.60 to 0.72 mg kg^{-1}. There is an including awareness of the need to pay greater attention in the role of macronutrients enhancement in the soil for good soil health and proper nutrition of plant so as to attain optimum economic yield and soil is suitable for all major tropical and sub-tropical crops.

Keywords: Nutrients; chemical and physical properties; soil quality indicators.

1. INTRODUCTION

Revolution in India is frequently discussed, as is its varied record of achievements and failures. The green revolution's technology resulted in a rise in the production of the majority of crops. Over the last few decades, the use of high yielding cultivars and excessive chemical fertilizers to optimise crop output in Indian agriculture has resulted in a slew of issues affecting soil health, fertility, productivity, the environment, and farmers themselves. In comparison to other countries' soils, India's fertility and production are currently very low. This is due to the combined effect of many variables such as a lack of moisture, a lack of plant nutrients, and poor soil management. It is critical to have a thorough understanding of the soil in order to improve soil production. Knowing the condition of plant nutrients in the soil aids in more over 70% of India's population is dependent on agriculture, either directly or indirectly. The green determining the amount and type of fertilizers and manures to apply to a specific crop, It aids in the avoidance of fertilizer-related economic losses Chaudhary et al. [1]. "Land use change causes significant alteration of soil reaction, soil organic matter (SOM), nutrient status, soil physical quality and microbial activity in the rhizosphere, observed that deforestation and intensive cultivation in the same land results in soil pH and acidification. Soil organic carbon (SOC) is generally considered as crucial regulating factor of both soil physical and chemical quality" Cotrufo et al. [2]. "About 30% loss of soil organic carbon due to conversion of natural grassland and forests into crop lands" Bot and Bnites [3]. **"**Soil fertility may be defined as the inherent capacity of soil to provide all essential nutrients in available form in a suitable balance for plant growth and development. According to soil fertility is the availability status of essential macro and micro nutrients in the soil. Conversion of land uses may change the soil propertie which affects the soil fertility" Onwudike et al. [4]. **"**Legume based cropping system has positively effects on soil structure improvement, enhanced phosphorus availability through secretion of enzymes and acids in the rhizosphere of legumes and enhance VAM colonization. Assessment of soil biological activities is also important to maintain the sustainability of soil ecology. Maintenance and improvement of soil health in continuous land use systems are very important to sustain agricultural productivity for the future which is not only helpful to the farming community in providing assured income but also protect the land from its degradation. A better understanding of the impact of land use system on chemical, physical and biological properties of soil is essential for evaluation of soil quality and thereby enhancing cropping system sustainability" Aparicio and Costa [5]. "Soil macro and micro nutrients availability and distribution are depends on soil pH, SOM contents and several physical, chemical and biological conditions of the rhizosphere. Different land uses play an important role in affecting soil quality and health by leaf litter, soil binding through root system, checking runoff, soil and nutrient losses *etc*. Land use system, defined as, the arrangements, activities and inputs people undertake in a certain land cover type to produce change or improve it cropping system can influence a range of soil properties depending on the specific crop rotations, nutrients amendments and tillage practices done" Masto et al. [6]).

2. MATERIALS AND METHODS

Soil sample collected with the help of soil auger from 7 departments (D_1- Soil Science and Agricultural Chemistry, D_2- Agronomy, D_3- Genetic and Plant Breeding, D_4- Horticulture, D_5- Plant Protection, D_6- Agro Forestry and D_7- Commercial Farm) of NAI, SHUATS, Prayagraj. Analysis of the soil samples were under the methods, the physical parameters include Soil colour, Soil texture, Bulk density, Particle density, Pore space, Water holding capacity, where as chemical parameters include pH, Electrical conductivity, Organic carbon, Macronutrients (N, P, K, Ca, Mg and S) and Micronutrients (Cu, Mn, Fe, B and Zn). Soil textural class was determined by using Hydrometer Bouyoucos [7]. Bulk density, Particle density, Water holding capacity was determined by using Graduated Measuring Cylinder method Muthuval *et al*. (1992). pH was estimated with the help of Digital pH meter after making 1:2.5 soil water suspension Jackson [8]. Electrical conductivity was estimated with the help of Digital conductivity meter Wilcox [9]. Percent Organic Carbon was estimated by Wet Oxidation method Walkley and Black [10]. Available nitrogen was estimated by Alkaline Potassium Permanganate method, using Kjeldahl apparatus Subbiah and Asija [11], Available Phosphorus was estimated by Photoelectric colorimeter method Olsen's et al. [12], Available Potassium was estimated by Neutral normal Ammonium Acetate extraction followed by Flame photometric method Toth and Prince [13]), available calcium and magnesium was estimated by EDTA Titration method Jackson [14], zinc estimated by Lindsay and Novell [15].

3. RESULTS AND DISCUSSION

3.1 Physical Properties

As given in Table 1 The soil textural classes identified as sandy loam. The sand, silt and clay percentage varied from 50 to 65% sand, 20 to 33% silt and 15 to 20% clay in Sandy Loam. Bulk density was varied from the 1.170 to 1.432 Mg m^{-3} and the highest Bulk density was found in D_2- agronomy. Particle density varied from 2.22 to 2.50 Mg m^{-3} and the highest Particle density was found in D_4- horticulture. The Pore Space ranged from 42.50 to 51.24%. The highest Pore space % was found at D_4- horticulture.

3.2 Chemical Properties

As given in Table 2 The pH value ranged from 7.37 to 7.78. The maximum value found in D_6- agro forestry. The electrical conductivity ranged from 0.28 to 0.44 dS m^{-1}. The maximum value found in D_2- agronomy and D_7- commercial farm. The value of organic carbon varied from 0.16 to 0.42% and the maximum value of organic carbon content was found in D_2- agronomy and D_7- commercial farm.

3.3 Macronutrients

As given in Table 3 The Available nitrogen content of soil ranged from 186 to 256 kg ha^{-1} and Nitrogen content was Medium in all departments .The Available Phosphorus content of soil ranged from 14.43 to 24.28 Kg ha^{-1}.The phosphorus content was found low to medium. Available Potassium content of soil ranged from 132 to 206 kg ha^{-1}. The potassium content was found Medium in range in all the departments [16].

3.4 Secondary Macronutients and Micronutient

As given in Table 4 The available calcium content of soil ranged from 0.97 to 1.88 cmol (p+) kg^{-1}, highest calcium was found in D_5- plant protection. The available magnesium content of soil ranged from 0.76 to 1.69 cmol (p+) kg^{-1}, highest magnesium was found in D_5- plant protection. The available zinc ranged from 0.60 to 0.72 mg kg^{-1}, highest zinc was found in D_7- commercial farm.

Table 1. Determination of bulk density, particle density and pore space in various depths at different research farm of NAI, SHUATS, Prayagraj

Soil sample	Bulk density (Mg m^{-3})			Particle density (Mg m^{-3})			Pore space (%)		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
D_1	1.172	1.195	1.220	2.31	2.35	2.39	48.22	44.34	42.50
D_2	1.332	1.384	1.432	2.35	2.38	2.39	50.28	47.53	44.56
D_3	1.227	1.259	1.265	2.42	2.46	2.49	51.14	47.68	43.78
D_4	1.221	1.249	1.254	2.48	2.49	2.50	51.24	48.33	44.26
D_5	1.195	1.222	1.248	2.22	2.28	2.31	50.14	47.32	44.18

Soil sample	Bulk density (Mg m^{-3})			Particle density (Mg m^{-3})			Pore space (%)		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
D_6	1.284	1.312	1.348	2.47	2.48	2.50	49.19	44.50	43.29
D_7	1.170	1.225	1.250	2.40	2.46	2.49	48.80	45.90	43.12
Result	S	S	S	S	S	S	S	S	S
S.E.m (±)	0.012	0.035	0.059	0.255	0.326	0.514	0.747	0.990	1.773
C.D. at 5%	0.026	0.074	0.124	0.507	0.649	1.023	1.584	2.098	3.759

Table 2. Determination of pH, electrical conductivity and organic carbon in various depths at different research farm of NAI, SHUATS, Prayagraj

Soil sample	pH			Electrical conductivity (dS m^{-1})			Organic carbon (%)		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
D_1	7.52	7.62	7.72	0.32	0.38	0.41	0.40	0.32	0.24
D_2	7.37	7.53	7.63	0.34	0.39	0.44	0.42	0.28	0.18
D_3	7.43	7.48	7.54	0.30	0.35	0.39	0.39	0.25	0.17
D_4	7.47	7.53	7.66	0.35	0.39	0.42	0.38	0.22	0.16
D_5	7.51	7.53	7.73	0.28	0.32	0.38	0.39	0.33	0.22
D_6	7.66	7.71	7.78	0.29	0.34	0.43	0.41	0.37	0.26
D_7	7.54	7.62	7.73	0.32	0.39	0.44	0.42	0.36	0.24
Result	S	S	S	S	S	S	S	S	S
S. E.m (±)	0.123	0.318	0.309	0.0247	0.0062	0.0044	0.0618	0.0310	0.1543
C.D. at 5%	0.263	0.677	0.657	0.0526	0.0132	0.0093	0.1316	0.0660	0.3286

S. S.E.m (±): Standard Error of Mean; C. C.D.: C Critical differences

Table 3. Determination of available nitrogen, available phosphorus and available potassium in various depths at different research farm of NAI, SHUATS, Prayagraj

Soil sample	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
D1	230.7	206.7	186.4	20.98	17.51	15.1	194	163	144
D_2	228.3	212.9	197.0	21.81	18.53	15.94	198	156	139
D_3	240.4	230.9	212.6	22.88	19.49	16.91	202	164	154
D_4	230.6	209.8	195.5	20.17	17.85	14.43	195	155	134
D_5	256.0	238.5	222.6	23.95	18.24	16.78	204	165	146
D_6	247.8	228.9	202.0	20.53	17.33	15.22	190	153	132
D_7	242.4	228.7	206.1	24.88	18.14	15.57	206	168	147
Result	S	S	S	S	S	S	S	S	S
S. E.m (±)	0.584	0.722	0.611	0.533	0.586	0.742	0.72	0.58	0.87
C.D. at 5%	1.237	1.531	1.296	1.129	1.243	1.573	1.53	1.24	1.85

D_1 – Soil science, D_2 – Agronomy, D_3 – GPB, D_4 – Horticulture, D_5 – Plant protection, D_6 – Agro-forestry, D_7 – Commercial farm

Table 4. Determination of available calcium, available magnesium and available zinc in various depths at different research farm of NAI, SHUATS, Prayagraj

Soil sample	Available Calcium (cmol (p+) kg^{-1})			Available Magnesium (cmol (p+) kg^{-1})			Available Zinc (mg kg^{-1})		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
D_1	1.22	1.12	0.98	1.03	0.92	0.76	0.68	0.66	0.65
D_2	1.32	1.23	1.06	1.13	1.04	0.87	0.66	0.64	0.62
D_3	1.22	1.13	0.97	1.06	0.94	0.78	0.64	0.62	0.60
D_4	1.82	1.73	1.65	1.63	1.54	1.46	0.62	0.61	0.60
D_5	1.88	1.75	1.67	1.69	1.56	1.48	0.67	0.65	0.62
D_6	1.62	1.53	1.45	1.43	1.32	1.22	0.63	0.61	0.60
D_7	1.68	1.59	1.51	1.49	1.40	1.32	0.72	0.70	0.67
Result	S	S	S	S	S	S	S	S	S
S. E.m (±)	0.002	0.110	0.181	0.634	0.104	0.055	0.0309	0.0261	0.0180
C.D. at 5%	0.005	0.233	0.383	1.344	0.221	0.118	0.0657	0.0555	0.0383

4. CONCLUSION

It is concluded that soil of all research farm of Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj have medium level in phosphorus and potassium, low in organic carbon and available nitrogen content, the best soil health parameters were found in the department of horticulture *viz.* soil texture sandy loam, highest percentage pore space and water holding capacity was found. Thus nutrients addition through inorganic fertilizer, organic manures and other sources are essential to maintain soil fertility and productivity of various department of NAI.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chaudhary A, Meena MC, Dwivedi BS, Datta SP, Parihar CM, Dey A. and Sharma VK. Effect of conservation agriculture on soil fertility in maize (*Zea mays*)-based systems. Indian Journal of Agricultural Sciences. 2019;89(10): 1654-9.
2. Cotrufo F, Conant R, Paustian K. Soil organic matter dynamics: land use, management and global change. Plant and Soil. 2011;338:1-3.
3. Bot A, Benites J. The importance of soil organic matter: Key to drought-resistant soil and sustained food and production. Rome, Italy: Food and Agriculture Organization of the United Nation; 2005.
4. Onwudike SU, Ihem EE, Irokwe IF, Onwuso G. Variability in the Physico-chemical Properties of Soils of Similar Lithology in Three Land Use Types in Ahiazu Mbaise, Imo State Nigeria. Journal of Agriculture and Crops. 2015;1(3): 38-43.
5. Aparicio V, Costa JL. Soil quality indicators under continuous cropping systems in the Argentinean Pampas Soil and Tillage Research. 2007;96(12): 155-165.
6. Masto RE, Chhonkar PK, Singh D, Patra, AK. Soil quality response to long term mitrient and crop management on a semi-arid Inceptisol, Agriculture Ecosystem and Environment. 2007;118:130–142.
7. Bouyoucos GJ. The Hydrometer as a new method for the mechanical analysis of soils, Soil Science. 1927;23: 343-353.
8. Jackson ML. Soil chemical analysis, Prentice hall of India. Private Ltd., New Delhi (1971); 1958.
9. Wilcox LV. Electrical conductivity, Amer. Water Works Assoc. J. 1950;l42:775-776.
10. Walkley A. Critical Examination of rapid method for determining organic carbon in soils, Soil Sci. 1947;632:251.
11. Subbiah BV, Asija CL. Rapid Procedure for the Estimation of Available Nitrogen in Soils. Current Sci. 1956;25:259-260.
12. Olsen SR, Cole CV, Watanble FS, Dean LA. Estimation of available Phosphorus in Soils by extraction with Sodium bicarbonate. USDA Circular No. 939; 1954.
13. Toth SJ, Prince AL. Estimation of Potassium content of Soil by Flame Photometer Technique, Soil Sci. 1949;67: 439-445.
14. Jackson ML. Chemical Analysis of Soil pH, Prentice hall of India Pvt. Ltd., New Delhi; 1973.

15. Lindsay WL, Norvell WA. Development of a DPTA soil test for heavy metals. Soil Science Society of America Journal. 1978;42:402-403.

16. Fisher RA. Statistical Methods and Scientific Induction, Journal of the Royal Statistical Society Series. 1960;17: 69-78.

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